U.S. Department of Transportation

Federal Aviation Administration

Memorandum

Subject:	Action: Review and Concurrence, Equivalent Level of Safety Finding for the Embraer Model ERJ-170 FAA Project Number TC0056IB-T	Date:	September 22, 2003
		Reg Ref:	§§ 25.904, 25.149, part 25 Appendix I
From:	Manager, TSS Propulsion/Mechanical Systems Branch, ANM-112	Reply to Attn of:	Lanny Pinkstaff ANM-112
To:	Manager, International Branch, ANM-116	ELOS Memo #:	TC0056IB-T-HDE-16

Background

The ERJ-170 aircraft design incorporates an automatic takeoff thrust control system (ATTCS) function in the engine full authority digital electronic control (FADEC) system architecture. The ATTCS system will automatically increase the thrust of the operating engine in the event of an engine failure during takeoff and go-around operations. 14 CFR part 25 Appendix I25.4(a) limits the intial takeoff thrust setting to not less than 90 percent of the ATTCS thrust.

The ERJ-170 FADEC control allows pilot selection of up to three takeoff thrust modes with well defined airplane and engine performance and engine limits. Each takeoff mode provides a different takeoff thrust level consistent with the takeoff thrust and derated takeoff thrust definitions and concepts contained in FAA Advisory Circular (AC) 25-13 and in JAA Advisory Material Joint (AMJ) 25-13. The pilot may switch the ATTCS ON or OFF for each takeoff thrust mode so up to six takeoff thrust levels are available for selection by the pilot.

Appendix I25 does not specifically address the use of ATTCS during reduced thrust operations. FAA AC 25-13 permits the use of ATTCS during reduced thrust operations, but does not allow performance credit for ATTCS operation. In the preamble to the FAA Final Rule for the ATTCS requirements, it is stated that the limitation on the initial takeoff thrust setting was based on providing a minimum performance level, minimizing crew workload in the event of a combined engine and ATTCS failure, and providing a simple, straightforward method for assuring a safe takeoff with all-engines-operating.

Embraer has requested limited performance credit for use of ATTCS during reduced thrust takeoffs. Specifically , they have requested performance credit for up to 111 percent of the initial, reduced thrust takeoff setting, when conducting reduced thrust takeoffs with ATTCS on. This is the same percentage performance credit permitted under I25.4(a) for normal takeoff thrust operations with ATTCS on.

Applicable regulation(s)
§§ 25.904, part 25 Appendix I25, 25.149
Regulation(s) requiring an ELOS
Part 25 Appendix I25.4(a)
Description of compensating design features or alternative standards that allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)
Compensating Design Features
The ERJ-170 is equipped with two GE CF34-8E engines that are controlled by a FADEC with an integrated ATTCS thrust control system that is part of the total TMS (thrust management system). The TMS structure allows pilot selection of up to three takeoff thrust modes with well defined airplane and engine performance and engine limits. The TMS allows the pilot to switch the ATTCS ON or OFF for each takeoff thrust mode so up to six takeoff thrust levels are available for selection by the pilot.
Simultaneous selection of reduced thrust takeoff and ATTCS ON can be easily performed. For reduced thrust takeoff in each takeoff thrust mode the only action required from the pilot is to insert the assumed temperature value in the takeoff data set page of the MCDU. All other procedures to be used during the takeoff remain unchanged when compared to the "normal" (non-reduced thrust) takeoff.

Alternative Standards
Performance credit will be permitted for up to 111 percent of the initial, reduced thrust takeoff setting, when conducting reduced thrust takeoffs with ATTCS on. Minimum control speeds during reduced takeoff thrust operations will be based on the full ATTCS thrust. Controllability must be demonstrated in accordance with § 25.149 for an ATTCS takeoff with engine failure, beginning with the minimum takeoff thrust available through reduced thrust procedures.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation
As noted in the Background section, the present limitation against ATTCS performance credit during reduced takeoff thrust operations is primarily associated with concerns about pilot workload in the event of a combined engine and ATTCS failure. The ERJ-170 engine thrust control/thrust management architecture with fully integrated ATTCS thrust control system provides a simple, consistent and straightforward procedure to allow simultaneous use of reduced thrust takeoff with ATTCS ON in all takeoff modes without introducing any additional pilot workload.

The reduced thrust takeoff performance credit for ATTCS will be limited to 111% of the reduced takeoff thrust setting. This limit is the same as provided for normal takeoff thrust operations with ATTCS. The actual engine thrust setting uptrim during reduced thrust operations may exceed that value, thus providing a further increase in actual airplane performance. Minimum control speeds will be based on the actual maximum rated ATTCS thrust for takeoff.

FAA approval and documentation of the ELOS
The FAA has approved the aforementioned Equivalent Level of Safety Finding as documented in Centro Técnico Aeroespacial Ficha de Controle Assuntos Relevantes HDE-16. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number should be listed in the Type Certificate Data Sheet under the

Certification Basis section. [e.g., Equivalent Safety Findings have been made for the following regulation(s):

14 CFR part 25 Appendix I25.4(a) Performance Credit for Use of Automatic Power Reserve (APR) during Reduced Thrust Takeoffs (documented in TAD ELOS Memo TC0056IB-T-HDE-16)]

original signed by Mahinder Wahi for NS — *9/25/03*

Manager, TSS, Propulsion/Mechanical Systems Branch, ANM-112 — Date

ELOS Originated by: Standards Staff, Propulsion Branch	Project Engineer Lanny Pinkstaff	Routing Symbol ANM-112